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MEASURING HUNTING PRESSURE ON CANADA GEESE IN THE FLATHEAD VALLEY[1]

John J. Craighead
U.S. Fish and Wildlife Service

Dwight S. Stockstad
Montana State Fish and Game Department

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[1]Contribution from the Montana Cooperative Wildlife Research Unit; U.S. Fish and Wildlife Service, Montana State Fish and Game Department, Montana State University, and Wildlife Management Institute cooperating. The study was largely supported with Federal Aid in Wildlife Restoration funds under Pittman-Robertson Project W-71-R-1, the Montana State Fish and Game Department.

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MEASURING HUNTING PRESSURE ON CANADA GEESE IN THE FLATHEAD VALLEY

Waterfowl management on a continental scale involves preserving and managing aquatic habitat, making annual breeding ground inventories and winter population counts, and conducting intensive research on waterfowl species and populations. Information obtained and put into practice has been vital in setting waterfowl regulations throughout the flyways. The regulations evolved have steadily improved waterfowl hunting.

Data accumulated to date show that as the human population expands it becomes more and more difficult to increase or even maintain adequate waterfowl habitat, that the management of such habitat for migratory birds is costly and highly complex, that to affect a reduction in nesting losses or otherwise increase productivity is difficult except on protected areas and even there it soon reaches a point of diminishing returns. Management of the harvest, however, still offers much room for improvement. Moreover, precisely managed waterfowl hunting appears to be a definite necessity in the future at the state, national, and international level.

Hickey (1955) points out the difficulties in controlling natural mortality and thoroughly discusses the biological basis of the hunter harvest. The hunter harvest probably lends itself to greater control and regulation by man than any other aspect of waterfowl management. Perhaps for this reason considerable effort has been expended to measure hunting pressure. Both Hickey (1955) and Elder (1955) have reviewed these efforts and the methods utilized. Rates of band recoveries and the use of a fluoroscope to detect the percentages of live ducks and geese carrying shot pellets have proved to be excellent techniques especially applicable to measuring hunting pressure on the major flyways (Hickey (1952), Cartwright and Law (1952), Whitlock and Miller (1947), Elder (1950) and Bellrose (1953)). A third

approach used by Hansen and Smith (1950) was to obtain kill estimates of Canada geese (Branta canadensis interior) where the population could be accurately inventoried and to convert the kill into percentages of the winter population. A fourth approach applicable to harvest areas where there are local populations of Canada geese (Branta canadensis moffitti), and therefore of special significance to the western states, is to accurately inventory the breeding population, determine its productivity, census the late summer and early fall population and measure the kill and the hunting pressure exerted. The Montana Cooperative Wildlife Research Unit in cooperation with the P-R Division of the Montana State Fish and Game Department has been conducting a study of this type in order to determine the long term effect of hunting pressure on a local goose population. The kill or harvest can be expressed in two ways: First, the local geese killed during any given year can be expressed as a percentage of the breeding population; second, the entire harvest of both local and migratory birds can be expressed as a percentage of the average hunting season population level.

In the course of this study it became apparent that hunting pressure was the major mortality factor on Canada geese in Western Montana. This supports the conclusions of Hanson and Smith for Canada geese of the Mississippi Flyway (1950). However, hunting pressure, like predation pressure, is complex, and though such pressure has been measured by many competent scientists, there has been no thorough analysis of the dynamics of hunting pressure. It must be thoroughly understood before more effective regulations can be formulated. This paper will be devoted to discussing some factors affecting the harvest of Canada geese in the Flathead Valley and will specifically treat the relationships between goose numbers, goose movement, hunting pressure and goose kill. In other words we will attempt to evaluate human predatory pressure on a prey species, the Canada goose.

During autumn a large share of the nation's waterfowl are concentrated on state and federal waterfowl sanctuaries. In some instances limited shooting is allowed but generally birds become available to hunters only as they move in or out of the refuges. This situation exists at Ninepipe and Pablo Reservoirs in the Flathead Valley, Montana.

The Area

The Flathead Valley is approximately 50 miles long varying in width from 8 to 20 miles. It contains several large water areas which include Flathead Lake and four reservoirs, the most important of which are Ninepipe and Pablo, both federal waterfowl refuges. The Flathead River runs the length of the valley. All the water areas are important in the ecology of the geese, but in the fall of the year a large share of the goose population concentrates on the two refuges (Figures 1 and 2) and thus the areas immediately adjacent to the refuges offer good hunting.

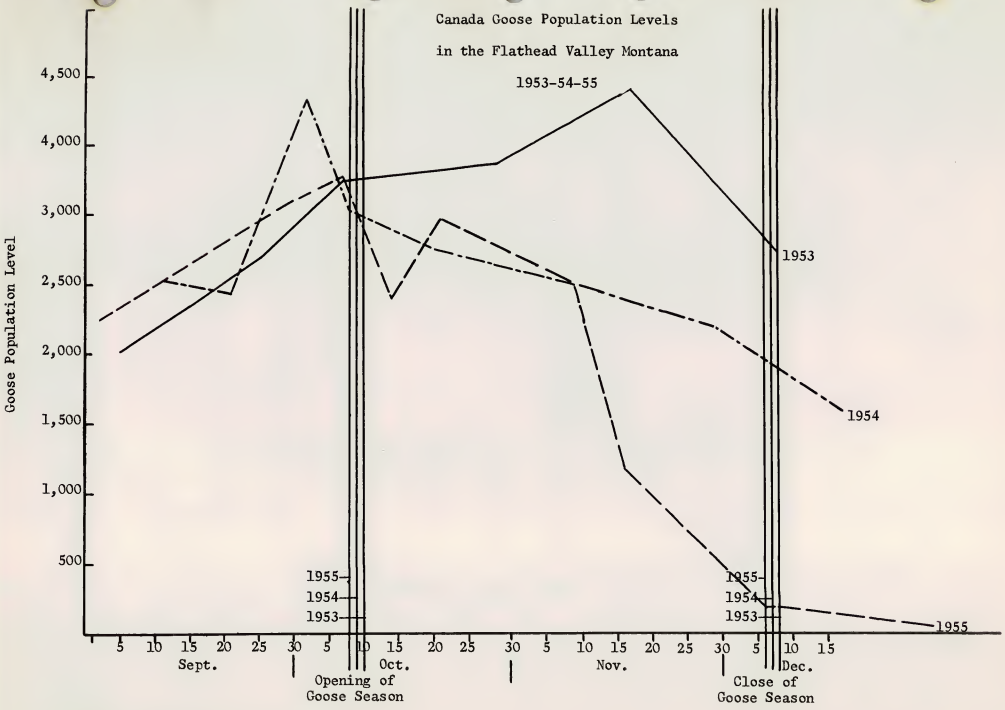
Ninepipe Refuge has a land and water area of 2,032 acres with 1,582 surface acres of water at an elevation of 3,010 feet. The water can be reduced to 84 surface acres at an elevation of 2,991 feet.

Pablo Refuge contains a land and water area of 2,540 acres with 2,070 surface acres of water at an elevation of 3,210 feet. This can be reduced to 260 surface acres at an elevation of 3,186 feet.

Ninepipe contains 14,870 usable acre feet of water when full and Pablo 27,100.

Procedure

In 1953, 1954, and 1955, hunting pressure on Canada geese and goose kills were measured throughout the entire Flathead Valley by means of field checks and hunter interviews during every day of the 60 day seasons. In addition Ninepipe and Pablo Reservoirs were selected for intensive study, zoned and observers assigned to specific stations to record goose movements as well as goose kills and hunting



Note: Ground and aerial censuses.

Figure 1

Relation of Goose Kill to Goose Numbers

Ninepipe and Pablo Reservoirs

1953-54-55

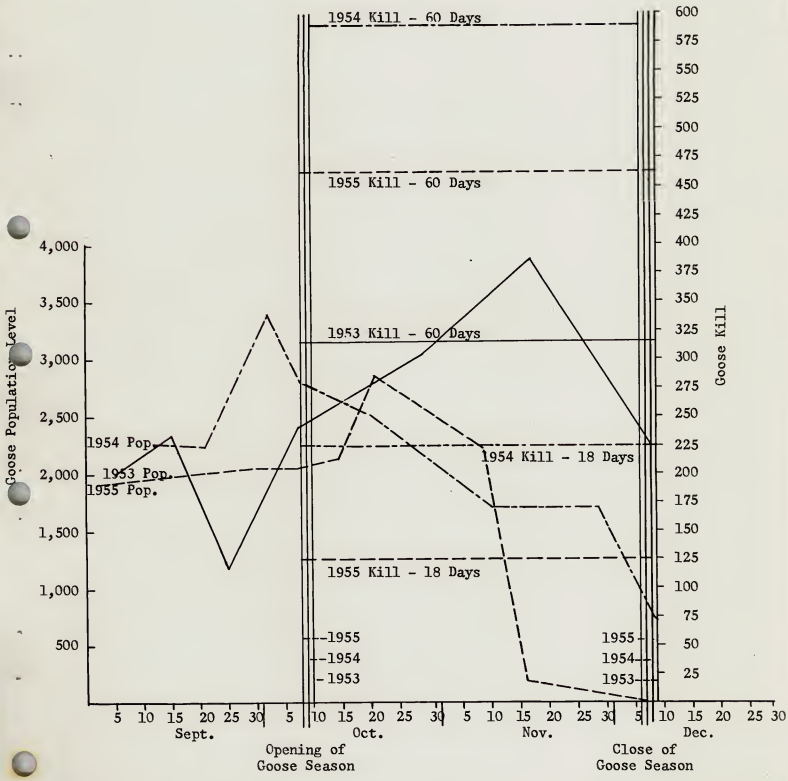


Figure 2

pressure. Ninepipe had three stations with an observer assigned to each station. Pablo had two stations and two observers. The areas were zoned in such a way that complete and continuous daily observations could be made. Each observer covered a designated area recording goose movements in and out of the refuges, tallying geese killed and crippled and recording hunting pressure in terms of hunter hours. Data were taken on form sheets and tabulated and cross checked with all observers at the end of each day. All goose movement in and out of the respective refuges could be observed from the stations as well as most movement of hunters to and from shooting pits and blinds. The killed and crippled geese were recorded from direct observations and later confirmed by hunter interview. The date, place of kill, and name of hunter was recorded for every goose bagged or crippled so there would be no possibility of confusion when field records were later checked against hunter interviews. Designated parking areas and check stations facilitated the recording of hunter pressure. Private shooting clubs and the intensive goose hunters cooperated enthusiastically in keeping records which were periodically checked against the field observations. Form sheets were issued for this purpose.

During the 1954 hunting season, data were taken on Ninepipe and Pablo Reservoirs on 15 and 14 weekend days respectively of the 60 day season and 6 and 4 week days. During the 1955 hunting season, data were taken on 18 weekend days at both reservoirs during a 60 day season. No data was taken on week days. Observations were recorded from daylight to dark. In 1954 and 1955 a total of 3,454 man hours were expended in field activities and 1,040 in 1953. Thus during three hunting seasons, 4,500 man hours were expended to obtain the data on goose numbers, movements, kill, and hunting pressure presented in this paper.

Population Levels

The Flathead goose population is relatively small and therefore could be quite accurately censused. Periodic aerial censuses were made of geese throughout the entire Flathead Valley from late summer until after the close of the hunting seasons. Both aerial and ground counts were made simultaneously at Pablo and Ninepipe Reservoirs during 1953, 1954, and 1955. Data on the nesting populations and their productivity (Geis, in press) supplemented with band returns and sight records of color marked birds showed that the hunting season goose population in the Flathead Valley was composed largely of local birds.

Figure 1 shows that during the three years of study, each hunting season opened with the goose population at 3,000 to 3,300 birds; but that this was followed by marked variations in population levels for the three years. In 1953 a steady increase in goose numbers occurred until after mid season. Then followed a slight decline. The population level remained generally high throughout the hunting season. In 1954 a steady decline occurred but there were still about 2,000 geese in the valley at the close of the season. The 1955 population remained high until about mid season, then suddenly dropped to a low level of 178 birds by December 6th. The average hunting season population figures for the entire Flathead Valley of 3,320, 2,613, and 2,127 for 1953, 1954, and 1955 respectively fairly accurately represent the hunting potential. A comparison of population levels throughout the valley (Figure 1) with those at Pablo and Ninepipe Reservoirs (Figure 2) shows that most of the geese in the Flathead Valley concentrate on the two reservoirs during the hunting season and it is there the heaviest hunting occurs. The fall goose populations consisted of both local and migratory geese, but at no time did migratory geese comprise more than 50 per cent of the populations and during the greater portions of each season resident birds comprised the largest segment of the respective populations.

Relation of Goose Kill to Goose Numbers

Figure 2 shows the relationships during three consecutive years of the kill (killed and crippled) of Canada geese to goose numbers or population levels. A direct relationship exists between the magnitude of the kill and the number of geese for two out of three years. However, the exception shows the smallest goose kill was made in 1953 when the highest population level prevailed. This inverse relationship of kill to goose numbers can be explained almost entirely by the fact that during the 1953 hunting season the reservoirs were at extremely low water levels. Ninepipe contained 84 surface acres of water as compared to 964 and 438 in 1954 and 1955 respectively. Pablo contained 260 as compared to 932 and 571 in the other years. The mud flats exposed at low water levels offer ideal feeding areas. Thus food was abundant and readily accessible on both refuges and as a result, goose feeding flights in and out of the areas were greatly reduced. Only 9 per cent of the average population level for the season moved each day. Relatively few targets were presented to hunters in spite of a large concentration of geese. This situation suggested the importance of goose movement as a factor in harvesting geese and detailed movement data were taken in following years.

The 1954 population level was generally higher than in 1955 and the kill greater (Figure 2). In 1955 a severe cold period beginning November 11th froze the reservoirs over night forcing the geese to leave. In less than a week the population dropped from 2,200 to less than 200. Most of these geese moved completely out of the valley. It is significant that the total of recorded kills for the 60 day seasons of 1954 and 1955 and the kills for weekend days on which movement was taken (Table 1 and Figure 2) all show a direct relationship to goose numbers.

TABLE I

GOOSE MOVEMENT AND KILL RELATED TO HUNTING PRESSURE

	NINEPIPE RESERVOIR - 1954[1]								PABLO RESERVOIR - 1954 & 1955[2]							
	AREA 1		AREA 2		AREA 3		AREA TOTAL		AREA 1		AREA 2		AREA TOTAL		ALL AREAS	
	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954-1955	
TOTAL NO. FLIGHTS	260	104	266	111	179	74	705	292	274	46	199	277	473	323	1,793	
TOTAL NO. OF GEESE FLYING	3,765	1,653	4,663	1,905	2,298	1,086	10,726	4,644	3,768	658	2,965	3,355	6,733	4,013	26,116	
NO. FLIGHTS OURING SHOOTING HOURS	217	99	212	105	161	68	590	272	258	46	185	270	443	316	1,621	
NO. OF GEESE FLYING DURING SHOOTING HOURS	3,253	1,582	3,707	1,767	2,069	945	9,029	4,294	3,518	658	2,741	3,226	6,259	3,884	23,466	
NO. OF FLIGHTS OVER HUNTERS	39	25	102	48	50	39	191	112	116	28	98	81	214	109	626	
NO. OF GEESE OVER HUNTERS	758	401	1,895	685	611	536	3,264	1,622	1,470	410	1,307	860	2,777	1,270	8,933	
% OF FLIGHTS OVER HUNTERS OURING SHOOTING HOURS	18.0	25.3	48.1	46.7	31.1	57.4	32.4	41.2	44.9	60.9	53.0	30.0	48.3	34.5	38.6	
% OF GEESE FLYING OVER HUNTERS OURING SHOOTING HOURS	23.3	25.4	51.1	38.8	29.5	57.7	36.2	37.8	41.8	62.3	47.8	26.7	44.4	32.7	38.1	
NO. OF GEESE KILLED	15	11	20	35	30	16	65	62	60	25	18	17	78	42	247	} 308 KILLED
NO. OF GEESE CRIPPLED	3	1	9	8	7	3	19	12	12	2	8	8	20	10	61	
% KILL OF GEESE MOVING OVER HUNTERS DURING SHOOTING HOURS	1.97	2.74	1.05	5.10	4.90	2.98	1.99	3.82	4.08	6.09	1.37	1.97	2.80	3.30	2.8 3.4	} AND
% KILL OF ALL GEESE MOVING OURING SHOOTING HOURS	0.46	0.69	0.54	1.98	1.44	1.69	0.71	1.44	1.70	3.79	0.65	0.52	1.24	1.08	1.1 1.3	CRIPPLED
NO. OF GEESE MOVING BEFORE AND AFTER SHOOTING HOURS	512	71	956	138	229	141	1,697	350	250	-	224	129	474	129	2,650	
% OF GEESE MOVING BEFORE AND AFTER SHOOTING HOURS	13.6	4.3	20.5	7.2	10.0	13.0	15.8	7.5	6.6	-	7.6	3.84	7.0	3.21	10.1	
NO. OF HUNTERS	240	195	310	326	395	304	945	825	1,149	693	339	201	1,488	894	4,152	
NO. OF HUNTER HOURS	466	470	601	848	998	903	2,066	2,221	2,993	2,408	1,264	696	4,259	3,104	11,650	
AVE. NO. OF HUNTER HOURS PER GOOSE KILLED (HUNTER SUCCESS)	31.1	42.7	30.0	24.2	33.3	56.4	31.8	35.8	49.9	96.3	70.2	40.9	54.6	73.9	38	
AVE. NO. OF HOURS PER HUNTER															2.81	

NOTE: 1. MEASURED ON WEEKENDS ONLY: 15 OAYS IN 1954 AND 18 DAYS IN 1955
2. MEASURED ON WEEKENDS ONLY: 14 OAYS IN 1954 AND 18 DAYS IN 1955

When kill data and goose numbers for 1953 are plotted separately for Pablo and Ninepipe, as shown in Figure 3, a direct relationship between goose numbers and size of kill is evident.

In 1954 there was again a direct relationship between population size and goose kill on both reservoirs for those days on which movement, kill, and hunting pressure were measured (Figure 4).

In 1955 an inverse relationship existed, the greater kill being obtained from the smaller population (Figure 5). This can be explained on a basis of goose movement and will be discussed later.

Tables 1 and 2 show that during both 1954 and 1955 more geese flew at Ninepipe than at Pablo in spite of the much higher population levels at Pablo. Also more of these geese passed over hunters. There was, however, less hunting pressure at Ninepipe than at Pablo, these values being 2,066 and 4,259 hunter hours respectively for 1954 and 2,221 and 3,104 for 1955. The lack of movement at Pablo counteracted the density relationship. In spite of more geese present fewer targets were presented to hunters. At Ninepipe during the former year the average number of hunter hours per goose killed was 31.8 while at Pablo it was 54.6. In 1955 these values were 35.8 and 73.9.

We can conclude that generally there tends to be a direct relationship between goose numbers and goose kill but that movement can completely alter this density relationship.

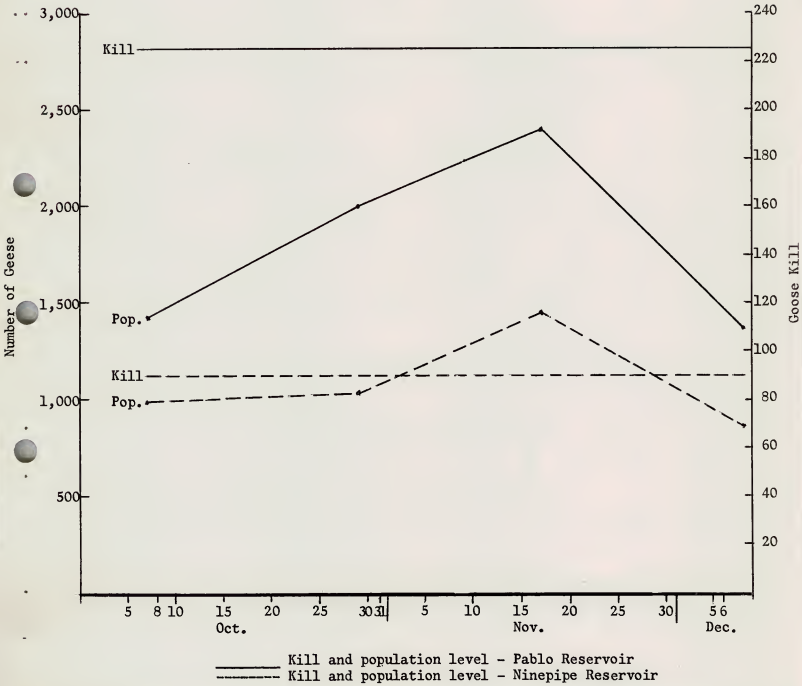
Relation of Goose Movement to Goose Numbers

In 1954, 1,489 goose flights were observed at Ninepipe and Pablo Reservoirs during 21 and 18 days respectively of the 60 day season. This included both week days and weekend days. These flights composed a total of 22,836 geese moving over

Relation of Goose Kill to Goose Numbers

at Pablo and Ninepipe Reservoirs

Entire 1953 Hunting Season



_____ Kill and population level - Pablo Reservoir

--------- Kill and population level - Ninepipe Reservoir

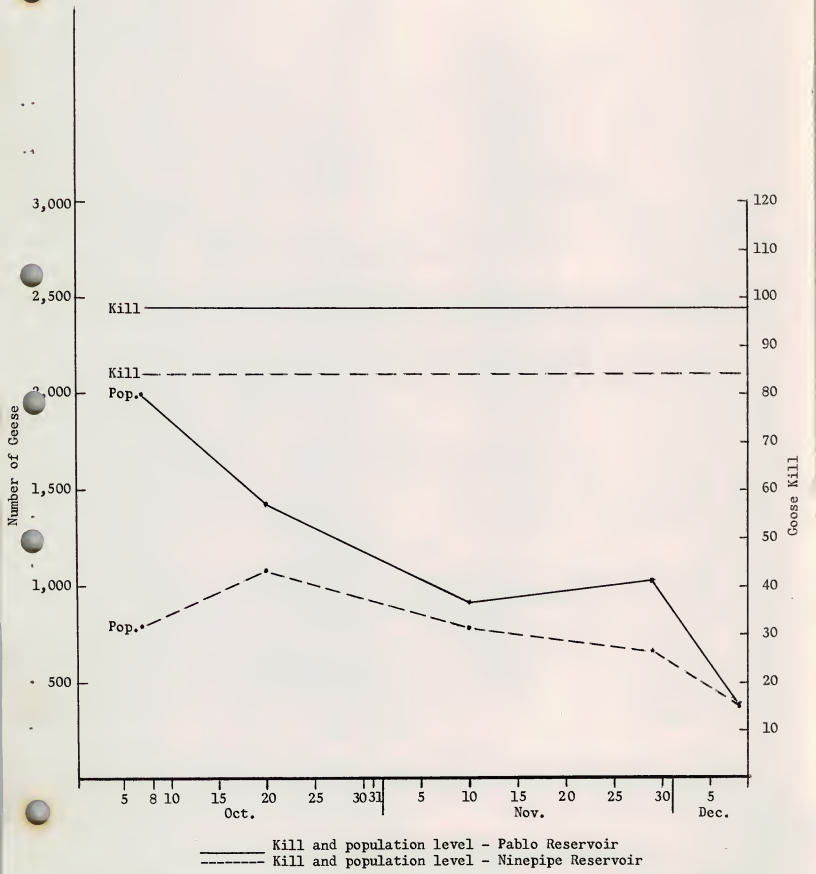
Note: Population levels based on 4 aerial counts and 4 supporting ground counts at each refuge.

Figure 3

Relation of Goose Kill to Goose Numbers at Pablo and Ninepipe Reservoirs

for Days on which Movement, Kill, and Hunting Pressure were Measured

1954 Hunting Season



_____ Kill and population level - Pablo Reservoir

-------- Kill and population level - Ninepipe Reservoir

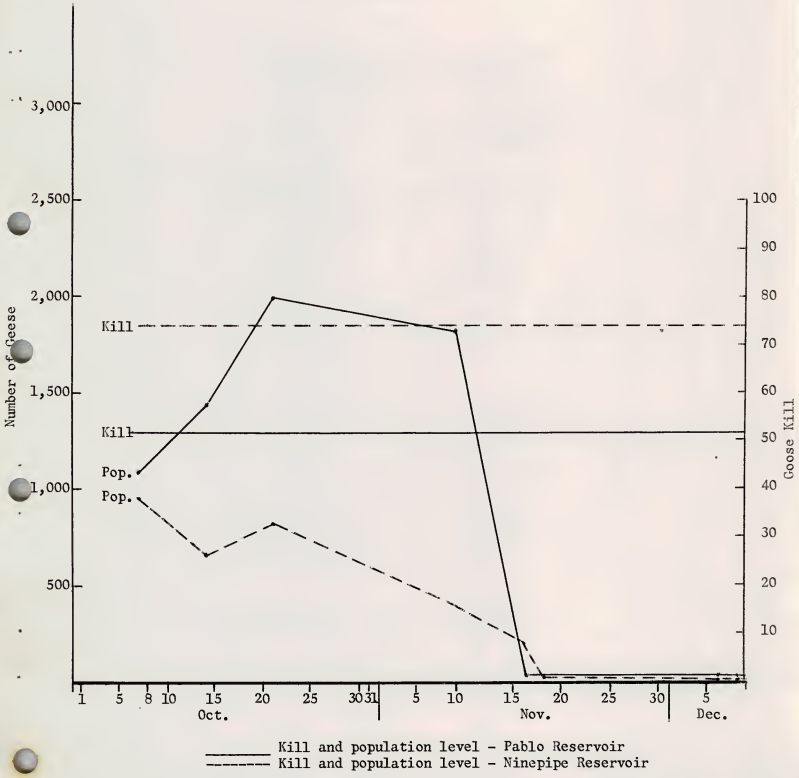
Note: Population levels based on 5 aerial counts and 5 supporting ground counts.

Figure 4

Relation of Goose Kill to Goose Numbers at Pablo and Ninepipe Reservoirs

for Days on which Movement, Kill and Hunting Pressure were Measured

1955 Hunting Season



Note: Population levels based on 7 aerial counts and 6 supporting ground counts.

Figure 5

Table 2

Goose Movement and Kill Related to Hunting Pressure at
Pablo and Ninepipe Reservoirs - 1954

Measured on 4 and 6 Week Days Respectively During the Hunting Season

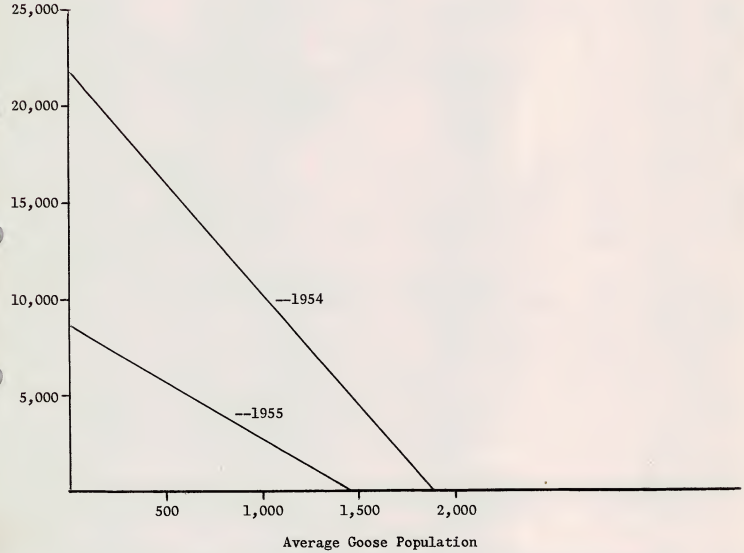
	Ninepipe Reservoir Area Total	Pablo Reservoir Area Total	Total Both Reservoirs	
TOTAL NO. FLIGHTS	186	125	311	
TOTAL NO. GEESE FLYING	3,450	1,927	5,377	
NO. FLIGHTS DURING SHOOTING HOURS	169	119	288	
NO. OF GEESE FLYING DURING SHOOTING HOURS	3,095	1,817	4,912	
NO. OF FLIGHTS OVER HUNTERS	40	40	80	
NO. OF GEESE OVER HUNTERS	586	562	1,148	
% OF FLIGHTS OVER HUNTERS DURING SHOOTING HOURS	23.7	33.6	27.8	
% OF GEESE FLYING OVER HUNTERS DURING SHOOTING HOURS	18.9	30.9	23.4	
NO. OF GEESE KILLED	27	17	44 } 56	
NO. OF GEESE CRIPPLED	1	11	12 }	
% KILL OF GEESE MOVING OVER HUNTERS DURING SHOOTING HOURS	4.60	3.02	3.83	5.00
% KILL OF ALL GEESE MOVING DURING SHOOTING HOURS	0.87	0.93	0.90	1.14
NO. OF GEESE MOVING BEFORE AND AFTER SHOOTING HOURS	355	110	465	
% OF GEESE MOVING BEFORE AND AFTER SHOOTING HOURS	10.3	5.7	8.6	
NO. OF HUNTERS	116	161	277	
NO. OF HUNTER HOURS	323.75	655.25	979.0	
AVE. NO. OF HUNTER HOURS PER GOOSE KILLED (HUNTER SUCCESS)	12.0	38.5	17.5	
AVE. NO. OF HOURS PER HUNTER			3.5	

hunting areas. We should expect to find a direct correlation between movement and numbers of geese. However, Figure 6 shows little correlation between movement and goose numbers when data for 1954 and 1955 are compared. Complete data for 1953 is not available but there appeared to be even less relationship between the degree of movement and the number of geese then, than in subsequent years. Furthermore, analysis of observations of movement for Ninepipe in 1954 and Pablo in 1955 showed no correlation between the number of geese in the two refuges and the number of geese moving (Figures 7 and 8). For example, during the early part of the 1954 season there were approximately 1,000 geese on Ninepipe and generally less than half this number were recorded as daily moving in and out of the refuge. Towards the end of the season when between 500 and 700 geese were present, over 150 per cent were recorded as moving. Thus the number of geese available as targets to hunters was considerably greater when the population level was low than when it was high. The ground and aerial censuses showed an average of 1,890 geese present in Ninepipe and Pablo Reservoirs during the hunting season. The tallies of movement for weekends and week days combined showed an average of 1,036 geese daily flew in and out of the refuges during shooting hours. Thus the geese moving in such a way as to present themselves as targets to hunters (within shooting distance) represented an average of 55 per cent of the average number of geese present during the season. This is in contrast to 10 per cent for 1953. Each record of a goose moving does not represent an individual goose. Some days during the 1954 season over two and a half times as many geese were observed moving as were known to be in the area. On the average, each goose presented itself as a target two and a half times during those days. A similar situation existed in 1955. At the opening of the season (Figure 8) as many geese moved as were known to be on Pablo Reservoir. Movement then dropped tremendously until mid November when again movement equalled or exceeded the number of birds present. The number of geese moving

Relation of Goose Movement to Goose Numbers

(Reservoir Data Combined)

1954–1955

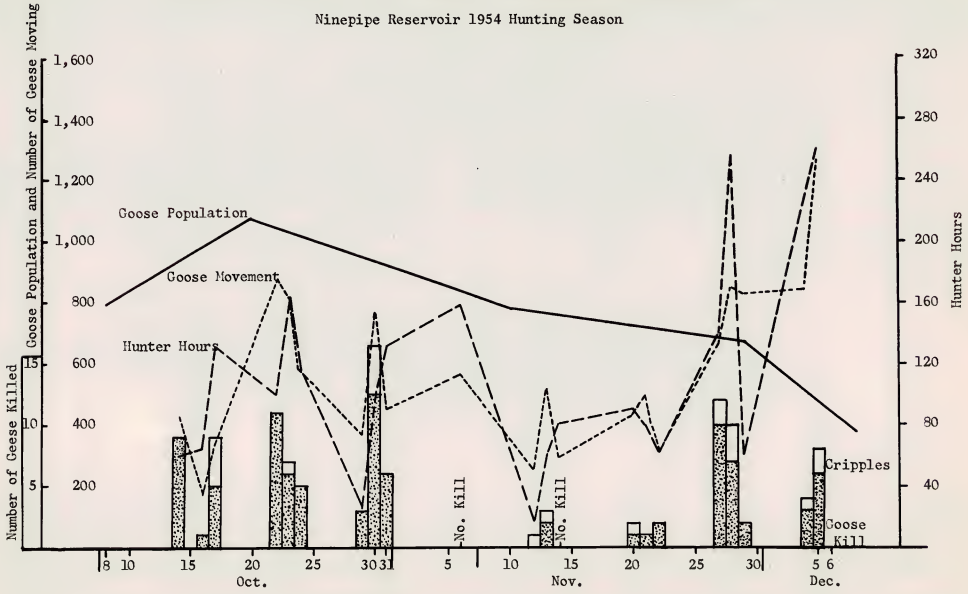


Note: Average populations based on five censuses made on comparable dates.

Figure 6

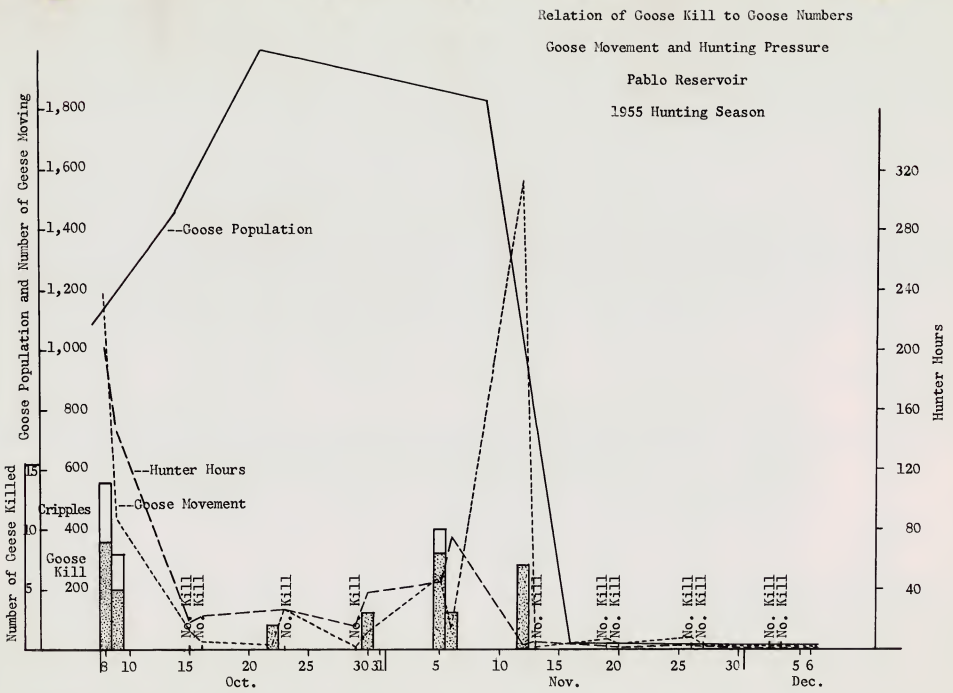
Relation of Goose Kill to Goose Numbers, Goose Movement and Hunting Pressure

Ninepipe Reservoir 1954 Hunting Season



Note: Movement recorded for legal hours only.

Figure 7



Note: Movement recorded for legal hours only.

Figure 8

in and out of the refuges rather than the total number of geese present, represented the potential shooting. Under favorable water and weather conditions, relatively few geese can have a high target value providing they move over shooting areas frequently. Conversely, large numbers of geese can have a low target value if they do not move regularly and frequently.

Data presented in Figure 9 is particularly interesting. It compares the movement of geese at Ninepipe during 1954 and 1955 with movement at Pablo during these same years. In 1954 the average population level at Pablo was considerably greater than at Ninepipe, these values being 1,151 and 739 respectively; yet the movement of geese at Ninepipe was greater than at Pablo, these values being 10,726 and 7,214 respectively. During 1955, Pablo on the average contained twice as many geese as Ninepipe (Figure 9) yet there was less movement of geese at Pablo. Thus during both years the degree of movement in relation to numbers was much greater at Ninepipe. One factor accounting for this is that more food is available on the Pablo refuge, but other factors as yet unknown may be important.

It is evident that movement as well as sheer numbers may have an important bearing on the number of geese harvested. As Table 1 shows, 158 geese were killed or crippled at Ninepipe compared to 150 at Pablo during both years. This in spite of the fact that both population level and hunting pressure were greater at Pablo. The disproportionate kill can be explained almost entirely on the basis of goose movement.

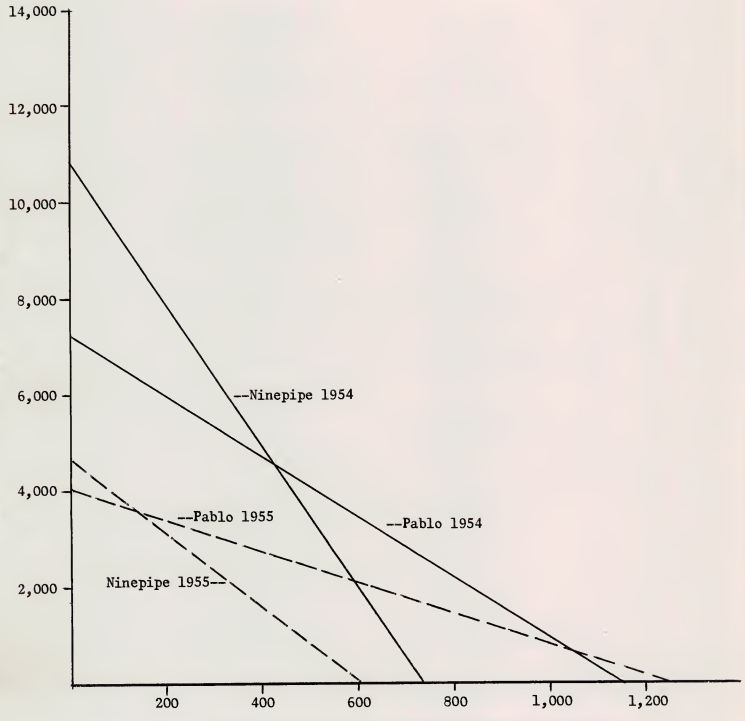
Figure 7 shows the relationship of goose movement to population level during weekends and week days at Ninepipe in 1954. Figure 8 shows this relationship for Pablo during weekends of 1955.

The tallies of movement (Table 1) show that 26,116 geese moved in and out of Ninepipe and Pablo during 1954 and 1955, on the weekend days when movement was recorded. This represents an average of 800 geese that daily flew in and out of

Relation of Goose Movement to Goose Numbers

on Pablo and Ninepipe Reservoir

1954-1955



Note: Movement measured during 15 days in 1954 and 18 days in 1955. Pablo data for 1954 weighted.

Figure 9

the refuges. Ground and aerial counts showed an average population level of 2,370 during the two seasons. Thus the geese presenting themselves as targets represented an average of 34 per cent of the average number of geese present during both seasons. There is a tremendous variation in goose movement from day to day, from place to place, and from season to season. The importance of movement as a factor in determining harvest is strikingly evident.

Relation of Kill to Movement

A direct relationship exists between the number of geese killed and crippled and the number of geese moving. Figure 10 shows that in 1954 with a movement of over 15,000 geese in and out of the two refuges during 29 recording days, 182 geese were killed and crippled. In 1955 with over 8,000 geese moving, 126 were killed and crippled. A similar relationship exists between the number of geese moving over hunters and the number of geese killed (Figure 10).

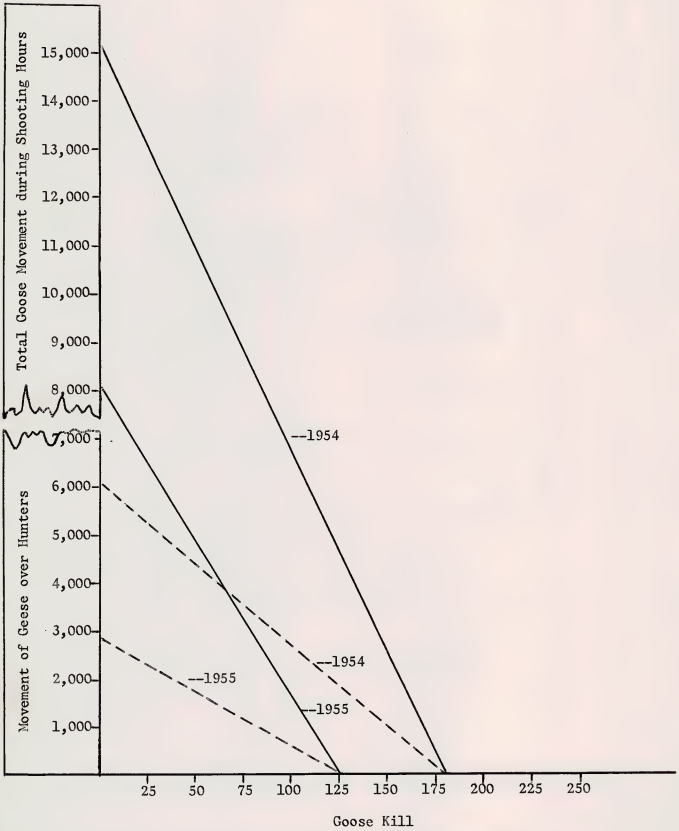
This same relationship holds true for both Ninepipe and Pablo Reservoirs when the data for these are evaluated separately. One specific example will suffice to show the general trend. On October 23, 1954, approximately 1,300 geese were on Pablo; 1,246 geese or 95 per cent moved to and from the Reservoir. One hundred and twenty-three hunters took 28 birds. A day later, October 24th, with approximately the same number of geese present, only 281 geese or 22 per cent moved. One hundred and twenty-four hunters (a hunting pressure equal to the preceding day) accounted for only 4 geese.

Figure 7 shows the relationship of kill to movement at Ninepipe during the 1954 hunting season. Through October an increase in movement invariably resulted in an increased kill. In November there were two exceptions to this trend. However, at the close of the season with the population level dropping steadily, goose movement increased to such an extent that approximately three times as many geese were recorded moving as there were individuals on the refuge. As a result

Relation of Goose Kill to Goose Movement

at Pablo and Ninepipe Reservoirs

1954-1955



Note: Reservoir areas combined for respective years.

Figure 10

the goose kill remained comparable to early season kills when the population level was much higher.

We can thus further confirm the importance of movement in determining kill. It can completely reverse the normal density relationship of goose kill to population level that we have earlier shown exists. A high population level with little movement results in a proportionately small kill; whereas a low population level with great movement results in a proportionately large kill. There are, of course, many intergradations between these extremes as Figures 7 and 8 illustrate.

Relation of Kill to Hunting Pressure

A third factor directly affecting the goose kill is hunting pressure. Table 1 summarizes the hunting pressure data obtained on Ninepipe and Pablo for weekend days of 1954 and 1955. During these two hunting seasons, 4,152 hunters exerting a total pressure of 11,650 hunting hours for an average of thirty-two and a half days each season accounted for 308 geese killed and crippled. This represents one goose killed for every 38 hunter hours. To bag these geese each hunter spent an average of 2.8 hours and an average of one goose was killed or crippled for every 13 hunters.

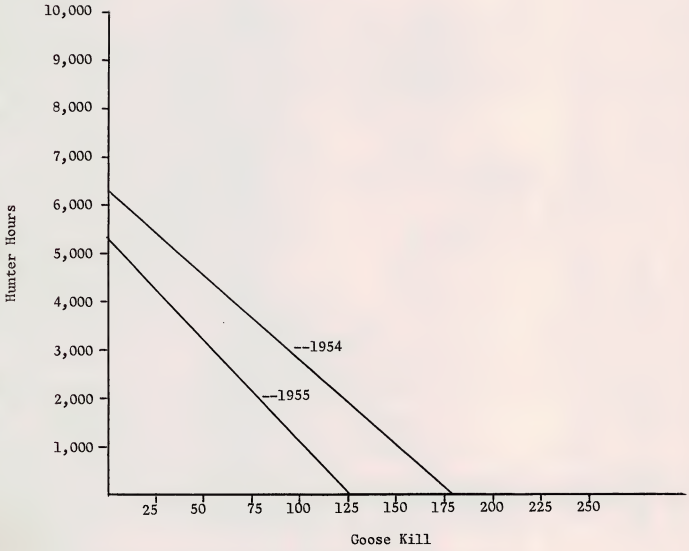
Of the geese moving over hunters during shooting hours, 3.4 per cent were killed and crippled whereas only 1.3 per cent of all geese moving during shooting hours were killed or crippled.

Figure 11 shows a direct relation between the number of geese killed and crippled and the number of hours spent hunting geese. The relationship between hunting pressure and kill is also evident from Figures 7 and 8. This is graphically shown for Ninepipe Reservoir during the 1954 hunting season and for Pablo during 1955 but it is typical of the situation for both reservoirs during both years. In general heavy kills occurred when hunting pressure was heavy. Low hunting pressure coinciding with a high population level, increased movement or

Relation of Goose Kill to Hunting Pressure

at Pablo and Ninepipe Reservoirs

1954-1955



Note: Reservoir areas combined for respective years.

Figure 11

both, generally did not result in a heavy kill. There were, however, exceptions to this rule. We can conclude that the magnitude of the hunting pressure is a vital factor determining the kill.

Relation of Kill to Goose Numbers, Goose Movement, and Hunting Pressure

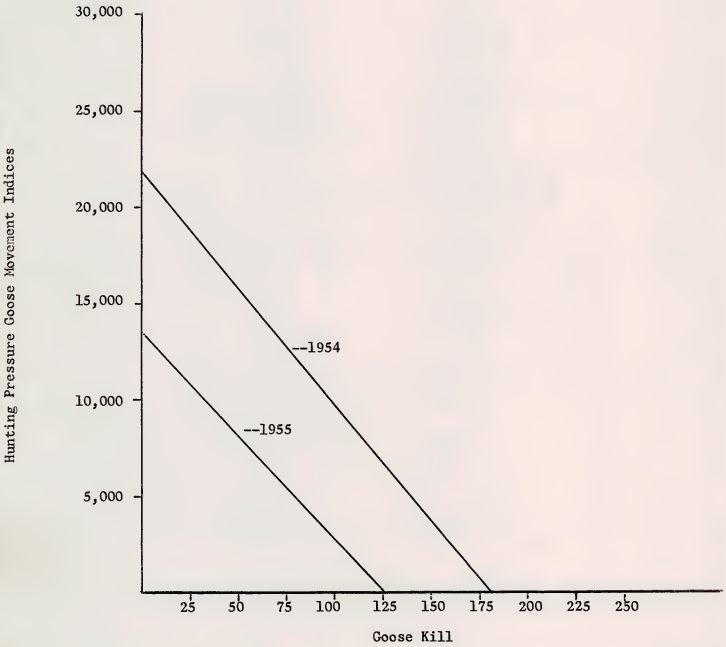
It has been shown that direct relationships exist between the number of geese killed and the goose population level, the movement of geese and the amount of hunting pressure exerted. It is evident from Figures 7 and 8 that any one of these three major factors affecting goose kill can be controlling depending on circumstances. In general the size of the goose population and the magnitude of the hunting pressure are basic. However, movement can alter the relationships in such a way as to at times completely reverse the density relationships of goose kill to goose numbers or goose kill to hunting pressure. Both goose movement and hunting pressure can be manipulated through management practices and it is important to note that when indices were formed by adding the values obtained for hunting pressure and goose movement for 1954 and 1955 and plotting the combined values against the kill for those years, it showed an almost perfect straight line relationship (Figure 12).

Relation of Goose Movement to Hunting Pressure

A common belief among local goose hunters is that geese soon learn where hunting pressure is great and contrive to leave the reservoirs through corridors where shooting is light or where hunting is prohibited or impossible due to physical barriers. On Ninepipe there were two corridors, one to the east and one to the west where geese could leave the refuge and attain considerable height before reaching a point where hunters could shoot at them. Movement data showed that relatively few flocks utilized these corridors and that probably no geese learned these flight lanes were relatively safe. Certain flocks followed well defined flight

Relation of Goose Kill to Hunter Pressure Goose Movement Indices

at Ninepipe and Pablo Reservoirs--1954-1955



Notes: Indices = Sum of hunting pressure and goose movement.
Reservoir areas combined for respective years.

Figure 12

patterns day after day in spite of formidable arrays of guns and men. Various flocks went to certain feeding and loafing areas and the general direction in which these lay appeared to determine the direction of flight.

In general, geese flew higher on clear days and as the season advanced, but this relation was not entirely consistent. Many low level flights occurred late in the season and went directly over areas of heavy hunting pressure. There was an excellent example of this at Pablo during 1953. One hundred and seventy-five geese were killed from a consistent local flight of about 300 geese that flew from Pablo Refuge to Flathead Lake in the evening, spent the night, returning to the refuge in the morning. The banded geese shot from this flight had all been banded at the West Polson Bay rearing grounds, the destination of the birds when they left the refuge. The persistence of the flight and the fact that between 50 and 200 of the geese were reared at Polson Bay in 1953 suggests a strong attachment for the rearing areas. This flight continued throughout the season in spite of the fact that approximately 60 per cent of the birds were killed. The flight was subjected to greater hunting pressure than any other segment of the population.

Geese were attracted to Pablo and Ninepipe Refuges long before the opening of the hunting seasons. By August many adults and immatures are gathered there. In 1954, 70.6 per cent of the entire valley population was concentrated there by mid August. In 1955, 83.4 per cent were tallied within the two refuges in early September. After the first week of hunting the birds react to the protection of the refuges by confining more of their activities to the areas, but during the three years of study there appeared to be no direct correlation between the daily movement of geese and the magnitude of hunting pressure. There is little doubt that hunting pressure restricted movement of geese, but it did not have a controlling effect on movement. Biological drives appeared to be far more important.

Another staunchly defended belief is that many geese move just prior to and just after shooting hours. Table 1 shows that in 1954 and 1955, 26,116 geese were recorded as moving at Ninepipe and Pablo during shooting hours and for half hour periods prior to and after shooting hours. Of this number only 2,650 or 10 per cent were recorded as moving before and after shooting hours. Thus 90 per cent of the geese moved out of the refuges as legal targets. However, the hunters have a legitimate "gripe" when they claim the geese are moving everywhere but over their pits. Only 38 per cent of all geese moving were recorded as flying over hunters during shooting hours. There is little evidence that this is due to learned behavior or goose intelligence but rather to the fact that on any given day hunters are so distributed that geese can leave without flying within range. As hunting pressure increases, the percentage flying over hunters will also increase. On some days when hunting pressure was great, between 50 and 70 per cent of the moving geese flew over hunters. It is apparent that goose movement is not something readily correlated with other factors. This we should expect. Geese being what they are, the frustrating question facing every goose hunter of where to make his stand to get some shooting, is likely to remain as frustrating as ever. That's what makes goose hunting a sport.

Other Factors Determining Goose Kill

We have presented the major factors determining the kill of Canada geese in the Flathead Valley and attempted to show how these factors are related. There are some minor factors operating within the controlling effect of these basic ones that should be considered. Although not fundamental, they have an important bearing on how and when the harvest is taken and some of them could conceivably be more controlling in other situations.

We could find no significant relation between daily local movement of geese in and out of the refuges and weather conditions. Some of the largest movements occurred on warm sunny days and conversely there was little movement on some of the cloudy or stormy days. However, as every goose hunter knows, weather affects goose hunting. It plays an important role on migratory flocks in the Mississippi Flyway, Hanson and Smith (1950) and Jahn, Gunther, and Bell (1954). In the Flathead Valley the approach of a storm front or a rapid drop in temperature brought migrant geese into the valley and moved others out. This generally affected the kill, but it was difficult to accurately measure.

The effect of weather on goose numbers through migratory movements was evident during all three years of the study but is best exemplified by what occurred on November 11, 1955. It snowed heavily all day with the temperature dropping steadily. No precise movement data was recorded but practically every goose on Ninepipe left before evening. The temperature continued to drop, reaching a low of -10° F. on the morning of November 12. All but a small portion of the reservoir was frozen and not a single goose remained. The same thing occurred at Pablo where the population dropped from over 2,800 to approximately 200 within 48 hours. These movements involved both resident and non-resident geese.

Visibility conditions and the skill and experience of the hunters to a large extent determine the effectiveness of hunting pressure. On Horicon Marsh, large kills were always registered on foggy mornings when the hunters could not see the birds (and vice versa) until they were in killing range, Jahn, Gunther, and Bell (1954). A similar trend was evident at Ninepipe and Pablo.

The quality of the hunting pressure has an important bearing on the magnitude of the kill and is a factor to consider in management. The weekend hunters in the Flathead Valley were largely novice goose hunters, while those

hunting during week days were largely intensive hunters with years of goose hunting experience behind them. Many of the latter took vacations during the waterfowl season, hunted geese day after day, studying goose movements, weather and food conditions. A considerable number belonged to shooting clubs bordering the refuges. Such conditions facilitated hunting. These hunters invariably had excellent equipment, were good shots and possessed the patience and stamina necessary for successful goose hunting. These intensive hunters not only hunted throughout most of the season, but they also were on hand season after season. The novice hunters were quite a different breed. In 1955, for example, 646 hunters of 993 interviewed were hunting geese for the first time. Only 347 were recorded as hunting in both 1954 and 1955.

A comparison of Table 1 with Table 2 shows the difference in quality of hunting pressure on week days as compared to weekends during 1954 and 1955. The per cent of goose flights and geese flying over hunters during shooting hours was significantly less during week days than weekends. This was because fewer hunters were out. The average number of geese moving was not significantly different. The per cent kill of geese moving over hunters during shooting hours, however, was 1.99 on weekends and 3.83 on week days. Similarly the average number of hunter hours per goose killed was 31.8 on weekend days and 17.5 on week days. The marked difference in hunter success was due to the increased percentage of experienced hunters. On weekends 3.4 per cent of all geese flying over hunters were killed or crippled, on week days 5.0 per cent were killed or crippled.

The quality of the hunting pressure can be readily evaluated from Tables 3 and 4. An effort was made to contact every goose hunter known to have hunted anywhere in the Flathead Valley. In 1954, 975 hunters were interviewed. Of this number 357 or 36.5 per cent were checked from one to many times in the

Table 3

DISTRIBUTION OF GOOSE KILL

Flathead Valley - 1954

No. of Hunters	% of Total Hunters	No. of Geese Killed	% of Total Geese Killed
1	.28	24	5.54
3	.84	70	16.17
4	1.12	84	19.40
5	1.40	95	21.94
7	1.96	115	26.56
8	2.24	124	28.64
13	3.64	164	37.88
16	4.48	185	42.73
18	5.04	197	45.50
22	6.16	217	50.12
30	8.40	249	57.51
46	12.89	297	68.59
76	21.29	357	82.45
152	42.58	433	100.00
357	100.00	433	100.00

Table 4

DISTRIBUTION OF GOOSE KILL

Flathead Valley - 1955

No. of Hunters	% of Total Hunters	No. of Geese Killed	% of Total Geese Killed
1	.24	19	3.73
3	.73	49	9.63
4	.97	60	11.79
7	1.69	90	17.68
10	2.42	117	22.99
12	2.90	133	26.13
14	3.38	147	28.88
17	4.11	165	32.42
31	7.49	235	46.17
46	11.11	295	57.96
67	16.18	358	70.33
103	24.88	430	84.48
182	43.96	509	100.00
414	100.00	509	100.00

field and then interviewed after the close of the season in order to obtain a complete record of geese killed and crippled and number of days and hours hunted. All field data were cross checked against the post-season interview data. Those hunters from whom complete data were obtained, hunted a total of 3,025 days, comprising 15,233 hunter hours, and killed 433 geese and crippled 80.

In 1955, 993 hunters were interviewed; 414 or 41.7 per cent were checked in the field and by post-season interview. The 414 hunters whose records were complete hunted a total of 2,101 days, comprising 13,476 hunter hours, and killed 509 geese, crippling another 68.

The distribution of kill among the hunters is revealing. Table 3 shows that in 1954 one hunter accounted for 24 geese, and that a relatively few hunters took a large share of the total kill. For example 22 hunters or 6.16 per cent killed 217 geese or 50 per cent of the total bag. Over half the hunters were unsuccessful in killing a goose.

Table 4 shows a similar situation in 1955. One hunter killed 19 geese, 3 killed 49, 4 killed 60; and 31 hunters or 7.49 per cent shot 235 geese representing 46 per cent of all the geese bagged. Again over half the hunters closed the season without a goose.

The role of the intensive and experienced goose hunter in the harvesting of the Flathead Valley geese must be considered in future management.

The Harvest

In 1953, 1954, and 1955 a minimum of 365, 645, and 732 geese were bagged by hunters in the Flathead Valley during the respective hunting seasons. The banded kill of locally banded birds was 43, 57, and 60 for those years. These banded kills represented 20.7, 13.6, and 15.8 per cent respectively of the populations banded each year. In 1953 resident birds composed 80 per cent of the total known kill. During

the following two years resident birds comprised 33.2 and 38.7 per cent of the total bag (computed on a basis of banded kill in the year of banding only). The exceptionally high kill of resident birds in 1953 was due largely to the excessive hunting pressure exerted on the Pablo-Polson Bay goose flight discussed earlier.

The number of geese known to have been killed and crippled for each of the three hunting seasons was 485, 764, and 803. This represents only those that could be definitely substantiated by field check and hunter interview. Thus in 1953, 14.6 per cent of the average hunting season population was killed and crippled. In 1954 and 1955 these values were 29.2 and 37.7.

From data at hand we could compute the percentage of the resident goose population annually killed and crippled. To have most significance such data should be compared with the reproductive capacity of the local goose population and this lies beyond the scope of the present paper.

Suffice it to say that it is too early in the study to determine whether the resident population can bear a heavier harvest or whether a reduction in the kill would be desirable. The fact that the nesting population has slowly increased during the past three years would indicate the resident population can support the current hunting pressure and kill. Nevertheless there appears to be little doubt that more precise management of the harvest will be necessary in the future.

Crippling Loss

The crippling loss for three years averaged 17.8 per cent of the hunter bag. However, a crippling loss of 24.7 per cent, determined from field observation and hunter interview during the days on which goose movement was recorded, is thought to more accurately represent the true situation.

Management Suggestions

Our analysis of factors affecting the harvest of Canada geese in the Flathead Valley suggests certain management practices. Since for two out of three years a direct relation existed between the number of geese killed and the magnitude of the population, an increase in the number of fall birds should normally improve hunting. The hunting population level can be increased in two ways, first by raising more geese in the Flathead Valley each year and second by attracting and holding more migratory geese. We have been investigating the first of these possibilities for three years but it will require several more years of intensive research before we can draw any firm conclusions. At this time, however, it does not appear feasible to either increase the nesting population or raise its productivity sufficiently to appreciably affect the hunting. No doubt more migratory geese could be attracted and held in the valley as has been done at Horicon Marsh and at Horseshoe Lake. The wisdom of such a practice is questionable and even were it attempted, the build-up would be relatively small - limited by the magnitude of the migratory flights.

There is little doubt that hunting pressure on geese in the Flathead Valley will expand greatly in the years ahead. Since the local goose population, even under intensive management, cannot conceivably be increased to meet this demand, other possibilities must be explored.

We have shown a direct relation between goose movement and kill and that movement is so important in determining hunter success that lack of it can completely offset the normal advantage of a high population level. Conversely excessive movement can more than compensate for a low population level. Movement, to some extent, can be manipulated and controlled, therefore it must be considered a major key in managing geese. Where underharvesting is a problem, movement could be induced; and

where there is danger of overharvest, it could be inhibited. Movement of geese in the Flathead Valley can be manipulated by regulating water levels, planting grain on the refuge areas to hold geese there, or establishing closed feeding areas outside the refuges to induce movement to protected feeding sites. Experiments are under way to determine the practicality of this type of management. It appears to offer real possibilities for the intensive management so inevitable in the future.

A direct relation between hunting pressure and goose kill has been shown. Most waterfowl regulations have been directed toward controlling the amount or type of hunting pressure, by setting the length of season, the daily shooting hours, and daily and possession bag limits. These are all federal regulations. However, in the Flathead Valley it may eventually become necessary for the State to add more precise restrictive measures on goose hunting in order to preserve the integrity of the local population. Possibilities are the zoning and limiting of hunting pressure, the closure of heavily hunted flight lanes when the kill has become excessive, limitations on week day hunting when relatively few hunters exert a telling pressure, and a limit on the number of geese bagged per hunter per season. If more drastic measures should prove necessary in the future, hunting pressure could be further reduced by shortening the goose season or by establishing a flexible split season that would focus more of the hunting pressure on the migratory geese.

Regulations based only on the annual flyway surveys will not be specific enough to insure effective harvesting of Montana's resident geese. They will have to be managed in the same way we manage upland game birds. This means the major responsibility will rest with the Montana State Fish and Game Department. To manage the local geese will require annual inventories of breeding success,

periodic censuses, and accurate records of the hunter harvest. This information, when combined with the annual flyway data, should enable the National Waterfowl Council, the Fish and Wildlife Service, and the Montana State Fish and Game Department to formulate local restrictions in the waterfowl regulations, pertaining to this and similar population units.

Summary

1. During 1953, 1954, and 1955, data were gathered on Canada goose numbers, goose movement, hunting pressure and goose kill in the Flathead Valley of Montana in order to evaluate the dynamics of hunting pressure.

2. The fall hunting population was composed largely of locally reared geese.

3. For two out of three years a direct relationship existed between the number of geese killed and crippled and the magnitude of the population levels. An inverse relationship existed during one year and this could be explained almost entirely by lack of goose movement in and out of Pablo and Ninepipe Refuges.

4. There was little correlation between goose movement and goose numbers.

5. A direct relationship was found between the number of geese killed and crippled and the number of geese moving. Movement can completely alter the density relationship of goose kill to goose numbers, and this is a significant factor in the management of Canada geese.

6. A direct relation existed between the number of geese killed and crippled and the number of hours spent hunting geese (hunting pressure).

7. When indices were formed by adding the values obtained for hunting pressure and goose movement for 1954 and 1955 and plotting the combined values against the kill for those years it showed an almost perfect straight line relationship.

8. Hunting pressure did not directly affect the daily movement of geese. Biological drives appeared to be more important.

9. During 1954 and 1955, 90 per cent of the recorded goose movement occurred in or out of the refuges during shooting hours.

10. There was no significant relation between daily local movement of geese in and out of the refuges and weather conditions.

11. Weather did affect migratory movements.

12. Skill and experience of the goose hunters to a large extent determined the effectiveness of the hunting pressure.

13. In 1953, 1954, and 1955, a minimum of 365, 645, and 732 geese were bagged by hunters in the Flathead Valley during the respective hunting seasons. The values for both killed and crippled were 485, 764, and 803 respectively. Thus in 1953, 14.6 per cent of the average hunting season population was killed and crippled. In 1954 and 1955 these values were 29.2 and 37.7.

14. Cripple loss averaged 24.7 per cent of the hunter bag.

15. Hunting pressure and goose movement are factors that can be manipulated and controlled, and offer the best possibilities for refining management of Canada geese in the Flathead Valley.

16. Basically, the harvest of Canada geese in the Flathead Valley should be managed in much the same way we manage harvests of local populations of upland game birds. It is largely a local problem concerned with resident geese.

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